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Washington, D.C. 20231

TRANSMITTAL FOR A NEWLY EXECUTED ORIGINAL APPLICATION UNDER 37 C.F.R. §1.53(b)

This is a request for filing a patent application under 37 C.F.R. §1.53(b) for:

Inventors: Manabu NOHARA, Takehiko SHIODA, Katsunori ARAKAWA, Osamu YAMAZAKI, Masami SUZUKI, Yasuteru KODAMA, Masahiro OKAMURA, Takayuki AKIMOTO and Hiroto INOUE

For: COMMUNICATING APPARATUS AND COMMUNICATING METHOD

1. This is a new [X] **Utility** [ ] **Design** [ ] **Plant** patent application.

2. The papers enclosed to obtain a filing date are as follows:
   - 31 Pages of Specification including
   - 0 Title Page
   - 3 Pages of Claims
   - 1 Page of Abstract
   - 8 Sheets of drawings containing 13 Figures
     - [ ] The enclosed drawing(s) are photograph(s), and there is also attached a PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)

3. Combined Declaration and Power of Attorney
   - [X] Enclosed and is executed by all inventors.
   - [ ] Not Enclosed.
     This application is being filed under the provisions of 37 C.F.R. §1.53(f). Applicant(s) await notification from the Patent and Trademark Office of the time set for filing the Declaration and paying the filing fees.

4. Language
   [X] English
   [ ] Non-English
   This application is being filed in accordance with 37 C.F.R. §1.52(d) and §608.01 of the MPEP. Applicant(s) await notification from the Patent and Trademark Office of the time set for filing the verified English translation and the processing fee.

5. Assignment

   [X] An assignment of the invention to Pioneer Corporation and a PTO Form-1595, Recordation Form Cover Sheet, are enclosed.

   [ ] An assignment will be filed at a later date.

6. Priority - foreign applications under 35 U.S.C. §119(a)-(d) or §365(b) or PCT international applications under 35 U.S.C. §365(a) designating at least one country other than the U.S.

   [X] Priority of the following foreign application is claimed:

Country	Application No.	Filed
Japan	11-256961	September 10, 1999

Certified copy: [X] is attached. [ ] will follow.

7. Priority based on provisional application(s) - 35 U.S.C. §119(e)

   [ ] Priority of the following provisional application(s) is claimed:

Application No.	Filed

A. Relate Back - 35 U.S.C. §119(e)

[ ] Amend the specification by inserting before the first line the sentence: "This application claims priority of copending provisional application(s) No. _______ filed on ________."

8. Small entity status

[ ] A statement claiming small entity status under 37 C.F.R. §§1.9 and 1.27 is enclosed.

9. Fee Calculation (37 C.F.R. §1.16)

CLAIMS FOR FEE CALCULATION				
	Number Filed	Number Extra	at Rate of	Basic Fee Utility $690.00 Design $310.00
Total Claims (37 C.F.R. §1.16(c))	6 - 20 =	0	$ 18.00 each=	$0.00
Independent Claims (37 C.F.R. §1.16(b))	2 - 3 =	0	$ 78.00 each=	$0.00
Multiple dependent claim(s), if any (37 C.F.R. §1.16(d))			$260.00	+
			SUB-TOTAL =	**$690.00**
			Reduction by 1/2 for filing by a small entity	**- $**
			TOTAL FILING FEE =	**$690.00**

10. Fee Payment

[ ] Not Enclosed. **NO FEE IS BEING PAID BY CHECK OR DEPOSIT ACCOUNT AT THIS TIME.**
This application is being filed under the provisions of 37 C.F.R. §1.53(f). Applicant(s) await notification from the Patent and Trademark Office of the time set for filing the Declaration and paying the filing fees.

[X] Please charge our Deposit Account No. 50-0310 for the filing fee of $690.00.

[ ] Enclosed.

Two checks in the amounts of $______ and $40.00 representing the basic filing fee of $690.00 and an assignment recording fee of $40.00 is/are enclosed.

11. [X] **Except** for issue fees payable under 37 C.F.R. §1.18, the Commissioner is hereby authorized by this paper to charge any additional fees during the entire pendency of this application including fees due under 37 C.F.R. §§1.16 and 1.17 which may be required, including any required extension of time fees, or credit any overpayment to Deposit Account 50-0310. This paragraph is intended to be a **CONSTRUCTIVE PETITION FOR EXTENSION OF TIME** in accordance with 37 C.F.R. §1.136(a)(3).

12. Additional papers enclosed:
    - [ ] Preliminary Amendment
    - [ ] Information Disclosure Statement
    - [ ] Form PTO-1449, ______ documents included
    - [ ] Declaration of Biological Deposit
    - [ ] Submission of "Sequence Listing", computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.

Please accord this application an application number and filing date.

Respectfully submitted,

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COMMUNICATING APPARATUS AND COMMUNICATING METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a communicating apparatus for and a communicating method of performing an asynchronous communication with a base station for example.

2. Description of the Related Art

As a communicating apparatus of this kind, there is a communicating apparatus using the CDMA (Code Division Multiple Access) method. For example, according to a movable body communicating system using the CDMA method on the business level, such a system structure is employed that a plurality of base stations are arranged for respective service areas, and that the asynchronous communication is performed between each base station and a communicating apparatus (i.e., a portable information terminal) carried by each user by means of wireless communication.

From the base station to the portable information terminal, a signal based on a format shown in FIG. 7 is transmitted for example. Namely, on the side of base station, a signal in which one wireless frame is constituted by 16 slots and a division signal called as a "long code mark symbol" to divide intervals of respective slots is inserted, is generated and transmitted. The portable information terminal receives a signal from the base station, detects a position of the long code mark symbol in the received signal, generates a base

band signal by performing an inverse-spreading process by a predetermined spread code series signal synchronous with the long code mark symbol, and reproduces the data in each slot by decoding the base band signal.

In order that the portable information terminal performs the asynchronous communication by selecting one appropriate base station from among a plurality of base stations and decodes the data in each slot in the received signal at a best condition, it is important for the portable information terminal itself to accurately detect the position of the long code mark symbol within the received signal so as to match the generating timing of the spread code series signal with the base station side.

In order to detect the position of the long code mark symbol, a receiving circuit shown in FIG. 8 is equipped in the above mentioned portable information terminal, and a process to establish the synchronization (synchronization capture) between the base station side and the terminal information terminal side is performed in advance of the actual start of the communicating operation such as a voice communication, a data communication and so on.

In FIG. 8, the receiving circuit is provided with an antenna 1 for receiving an electric wave from a base station, and a slot search circuit 3 to which the signal received by the antenna is inputted through an RF (Radio Frequency) circuit 2. The slot search circuit 3 is provided with a matched filter 4, an adder 5, a memory unit 6 and a peak judging unit 7.

The matched filter 4 is a correlating device, performs a

correlating calculation between a received signal Sin from the RF circuit 2 and the predetermined code series data (i.e., the data in the same series as the long code mark symbol), and detects the position of the long code mark symbol on the basis of a phase shift amount when the correlation value becomes the maximum.

More concretely, as shown in FIG. 7, by dividing one slot term by a time width τ, which is one tenth of a chip duration Tc (= Tc/10), into 2560 points, the matched filter 4 performs the above mentioned correlating calculation, by using this time width τ as the phase shift amount, to thereby obtain the correlation value for every point i = 1 to 2560 in the one slot term.

However, since the base station spreads the transmission signal to a wide band by a spectrum-spreading process, the S/N (Signal to Noise ratio) of the received signal is deteriorated at the portable information terminal, and the S/N of the correlation value is also deteriorated. Thus, it is generally difficult to accurately detect the position of the long code mark symbol on the basis of the correlation value obtained by the correlating calculation for just one slot term.

Therefore, the matched filter 4 repeats the correlating calculation for a plurality of slot terms (e.g., 32 slot terms), and the adder 5 adds and accumulates each calculated correlation value for each point i (i.e., for each phase shift amount) to thereby obtain the accumulated additional values each having a high S/N.

In order to obtain the accumulated additional value having the high S/N, 2560 memory areas AP(1) to AP(2560) are prepared to

store the 2560 correlation values corresponding to the 2560 points in advance. When the matched filter 4 calculates the 2560 correlation values for each slot term, the adder 5 accumulates these newly calculated 2560 correlation values and the 2560 correlation values already stored in the memory unit 6 correspondingly for each point i (i.e., for each phase shift amount). Then, the matched filter 4 assigns and stores the 2560 accumulated correlation values again to the memory areas AP(1) to AP(2560). Then, by repeating those processes of the correlating calculation and the accumulation for a plurality of slot terms, a distribution of the accumulated additional value having the high S/N as shown in FIG. 9 is generated.

The peak judging unit 7 detects the greatest 20 accumulated additional values and the positions of the points i corresponding to those 20 accumulated additional values, from among the 2560 accumulated additional values, which have been accumulated over a plurality of slot terms and are finally stored in the memory areas AP (1) to AP(2560), to thereby generate a histogram as shown in FIG. 10. Further, on the basis of 20 points k in this histogram, the peak judging circuit 7 judges the position of the long code mark symbol in the received signal Sin, and establishes the synchronization (synchronization capture) to perform the asynchronous communication by selecting an appropriate base station. Then, by supplying this judgment result output to the spread series signal generator (not illustrated) equipped in the signal wave-detecting circuit, and by synchronizing the generation timing of the spread series signal to inverse-spread the received signal Sin with the

position of the long code mark symbol, the base band signal decodable at the best condition is generated.

However, in the above mentioned portable information terminal, since a large amount of accumulated additional values i.e., the 2560 accumulated additional values are calculated, the memory unit 6 having a large memory capacity is equipped. Thus, there is a problem of an increase of the electric consumption, an increase of the cost and an increase of the apparatus size.

Especially, in order to accurately detect the position of the long code mark symbol by the above mentioned correlating calculation, it is desirable to improve the phase resolution of the correlation value by decreasing the time width τ (or the phase shift amount) as short as possible with respect to the chip duration Tc. However, as the time width τ is made the shorter, the total number of the points i in one slot term increases. Thus, there is such a problem that the memory unit 6 having an enormous memory capacity is necessary in accompaniment with the increase of the total number of the points i.

In case that the chip duration Tc with respect to a bit duration T i.e., a spreading ratio T/Tc is large, since the total number of the points i in one slot term increases, there is such a problem that the memory unit 6 having an enormous memory capacity is necessary in accompaniment with the increase of the total number of the points i.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a communicating apparatus and a communicating method, which can perform synchronization capturing at a high accuracy by using a memory having a relatively small memory capacity.

The above object of the present invention can be achieved by a communicating apparatus for performing an asynchronous communication with a base station. The communicating apparatus is provided with: a receiving device for receiving a down link signal, which is transmitted from the base station and in which a division signal is inserted for each of constant time intervals; a detecting device for detecting division signals out of the received down link signal, in phase to the constant time intervals; an adding device for adding the detected division signals over a predetermined time duration, which is longer than the constant time interval, with matching phases for each of the constant time intervals, so as to generate accumulated additional values; and a memory device for storing the accumulated additional values generated by the adding device, to thereby perform synchronization capturing with the base station on the basis of the accumulated additional values added over the predetermined time duration and stored in the memory device.

According to the communicating apparatus of the present invention, the accumulated additional values are not generated for all of the received down link signal, but are generated just for the division signals in the received down link signal. Thus, the memory capacity of the memory device for storing the accumulated additional values can be drastically reduced.

In one aspect of the communicating apparatus of the present invention, the detecting device calculates a correlation between a signal correlated with the division signal and the received down link signal, and detects the division signal out of the received down link signal when the calculated correlation exceeds a predetermined threshold value.

According to this aspect, the timing when the calculated correlation exceeds the threshold value can be accurately detected as the position of the division signal included in the received down link signal. Then, by generating the accumulated additional signals just for the division signals each time the calculated correlation exceeds the threshold value, the memory capacity of the memory device for storing the accumulated additional values can be drastically reduced.

In another aspect of the communicating apparatus of the present invention, the memory device has a plurality of memory areas to store the accumulated additional values with packing each of the accumulated additional values in respective one of the memory areas, when the adding device generates the accumulated additional values by adding at different timings within the constant time interval.

According to this aspect, the respective accumulated additional values are not stored into different memory areas each time when each of the accumulated additional value is generated. Thus, the memory capacity of the memory device for storing the accumulated additional values can be drastically reduced.

The above object of the present invention can be also achieved by a communicating method of performing an asynchronous communication with a base station. The communicating method is provided with: a receiving process of receiving a down link signal, which is transmitted from the base station and in which a division signal is inserted for each of constant time intervals; a detecting process of detecting division signals out of the received down link signal, in phase to the constant time intervals; an adding process of adding the detected division signals over a predetermined time duration, which is longer than the constant time interval, with matching phases for each of the constant time intervals, so as to generate accumulated additional values; and a storing process of storing the accumulated additional values generated by the adding process into a memory device, to thereby perform synchronization capturing with the base station on the basis of the accumulated additional values added over the predetermined time duration and stored in the memory device.

According to the communicating method of the present invention, the accumulated additional values are not generated for all of the received down link signal, but are generated just for the division signals in the received down link signal. Thus, the memory capacity of the memory device can be drastically reduced.

In one aspect of the communicating method of the present invention, the detecting process calculates a correlation between a signal correlated with the division signal and the received down link signal, and detects the division signal out of the received down link

signal when the calculated correlation exceeds a predetermined threshold value.

According to this aspect, the timing when the calculated correlation exceeds the threshold value can be accurately detected as the position of the division signal included in the received down link signal. Then, by generating the accumulated additional signals just for the division signals each time the calculated correlation exceeds the threshold value, the memory capacity of the memory device can be drastically reduced.

In another aspect of the communicating method of the present invention, the memory device has a plurality of memory areas, and the storing process stores the accumulated additional values with packing each of the accumulated additional values in respective one of the memory areas, when the adding process generates the accumulated additional values by adding at different timings within the constant time interval.

According to this aspect, the respective accumulated additional values are not stored into different memory areas each time when each of the accumulated additional value is generated. Thus, the memory capacity of the memory device can be drastically reduced.

The nature, utility, and further features of this invention will be more clearly apparent from the following detailed description with respect to preferred embodiments of the invention when read in conjunction with the accompanying drawings briefly described below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing a structure of a portable information terminal as an embodiment of the present invention;

FIG. 2 is a diagram showing a structure of a main memory unit and a temporary memory unit in the embodiment;

FIG. 3A is a diagram for explaining functions of the main memory unit and the temporary memory unit as well as a memory controller in one condition in the embodiment;

FIG. 3B is a diagram for explaining functions of the main memory unit and the temporary memory unit as well as a memory controller in another condition in the embodiment;

FIG. 3C is a diagram for explaining functions of the main memory unit and the temporary memory unit as well as a memory controller in another condition in the embodiment;

FIG. 3D is a diagram for explaining functions of the main memory unit and the temporary memory unit as well as a memory controller in another condition in the embodiment;

FIG. 4 is a graph showing the accumulated additional values finally stored in the main memory unit in the embodiment;

FIG. 5 is a histogram generated on the basis of the greatest 20 accumulated additional values among the accumulated additional values finally stored in the main memory unit in the embodiment;

FIG. 6 is a flow chart showing an operation of the portable information terminal of the embodiment;

FIG. 7 is a diagram showing formats of a signal transmitted

from a base station and a received signal;

FIG. 8 is a block diagram showing a structure of a portable information terminal according to a related art;

FIG. 9 is a graph showing the accumulated additional values finally stored in the memory unit in the portable information terminal of the related art; and

FIG. 10 is a histogram generated on the basis of the greatest 20 accumulated additional values among the accumulated additional values finally stored in the memory unit in the portable information terminal of the related art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the accompanying drawings, an embodiment of the present invention will be now explained. In the present embodiment, the present invention is applied to a portable information terminal using the CDMA communication method. FIG. 1 is a block diagram showing a structure of a portable information terminal as an embodiment of the communication apparatus of the present invention.

In FIG. 1, the portable information terminal is provided with an antenna 8 for performing a communication with a base station, an RF circuit 9 for amplifying a received signal which is received by the antenna and outputting it, a synchronization capturing unit 10 and a decoding unit 11. To each of the synchronization capturing unit 10 and the decoding unit 11, the received signal Sin from the RF circuit 9 is inputted.

The synchronization capturing unit 10 is provided with a matched filter 12, a comparator 13a, a threshold generator 13b, a memory controller 14, an adder 15, a memory unit 16, a slot timing generator 17 and a spread series generator 18.

The decoding unit 11 is provided with a band pass filter (BPF) 19, a multiplier 20 and a decoder 21.

The matched filter 12 is a correlating device for performing a correlating calculation promptly when the received signal Sin is inputted thereto in synchronization with the time width τ as described later, and may comprise a SAW (Surface Acoustic Wave) element, a CCD (Charged Coupled Device) and the like. More concretely, an elastic type SAW convolver device is employed here as the correlating device, in which the tap number is set to 256. The matched filter 12 performs a mutual correlating calculation between the received signal Sin and the predetermined code series data Drf, and outputs a correlation value Pi, which is a result of the correlating calculation, to the comparator 13 and the adder 15.

For the sake of the explanation, it is assumed here that the signal from the base station is based on the format shown in FIG. 7 i.e., one wireless frame has 16 slots and the long code mark symbol, which is a dividing signal to divide the respective slot intervals, is inserted. Thus, the received signal Sin outputted from the RF circuit 9 is also based on the format shown in FIG. 7.

On the other hand, the code series data Drf is set in advance to the matched filter 12. The code series data Drf is a code series, whose correlation with the long code mark symbol or the code series

same as the long code mark symbol is high.

In the same manner as shown in FIG. 7, one slot term of the received signal Sin is divided by a time width τ, which is one tenth of a chip duration Tc (= Tc/10), into 2560 points. Further, the matched filter 12 performs the above mentioned correlating calculation, by using this time width τ as the phase shift amount, to thereby obtain the correlation values P1 to P2560 for the 2560 points in the one slot term.

Therefore, the matched filter 12 performs the correlating calculation collectively for the code series data Drf and the received signal Sin in the amount of the 256 taps, and further performs the above mentioned correlating calculation while the received signal Sin is being inputted (or being phase-shifted) in synchronization with the time width τ, to thereby output the maximum correlation value at the time when the phase of the code series data Drf and the long code mark symbol in the received signal Sin are coincident with each other. This maximum correlation value is equivalent to the long code mark symbol.

The matched filter 12 performs the correlating calculation over a plurality of slot terms (e.g. 32 slot terms). Namely, the matched filter 12 performs the correlating calculation 32 times repeatedly so as to obtain the correlation values P1 to P2560 in the amount of 60 points per one slot term.

The comparator 13a compares each correlation value Pi (i corresponds to any point of the points 1 to 2560) which is outputted sequentially from the matched filter 12 in synchronization with the

time width τ, with the threshold value THD, and outputs a comparison signal CMPi, which becomes a logical "1" if Pi $\geqq$ THD and a logical "0" if Pi < THD. Namely, the comparator 13a constitutes a detecting device for detecting the long code mark symbol included in the received signal Sin in cooperation with the matched filter 12.

The threshold generator 13b integrates the received signal Sin for a predetermined time duration and multiplies a time average of the integrated value with a proportional coefficient α to thereby generate the threshold value THD.

The proportional coefficient α is a fixed value determined by an experiment etc., to automatically generate the threshold value THD such that, in the correlating calculation, the correlation value Pi, which is generated when the phases of the long code mark symbol in the received signal Sin and the code series data Drf are approximately coincident with each other, is greater than the threshold value THD and the correlation value Pi, which is generated when the phases of the long code mark symbol in the received signal Sin and the code series data Drf are drastically offset to each other, is smaller than the threshold value THD.

The memory controller 14 controls the adder 15 and the memory unit 16 in accordance with the logical value of the comparison signal CMPi. When the comparison signal CMPi is the logical "1", the memory controller 14 controls the newest correlation value Pi calculated by the matched filter 12 at the moment to be inputted to the adder 15, and. The memory controller 14 accesses

the memory unit 16 to read out the accumulated additional value P(i) corresponding to the point (phase shift amount) i of the correlation value Pi and supplies it to the adder 15. The memory controller 15 controls the adder 15 to perform the adding calculation of the accumulated additional value P(i) and the correlation value Pi.

When the adder 15 outputs the additional value "Pi + P(i)" after adding the correlation value Pi and the accumulated additional value P(i), the memory controller 14 accesses the memory unit 16 again at the memory area where the accumulated additional value P(i) is stored, and stores the additional value "Pi + P(i)" as the new accumulated additional value P(i) into the memory area (the same memory area).

On the other hand, when the comparison signal CMPi is the logical "0", the control for the above mentioned adding calculation is stopped.

Therefore, only in case that the comparison signal CMPi is the logical "1", the memory controller 14 controls the adder 15 to perform the adding calculation of the accumulated additional value P(i) and the correlation value Pi corresponding to the point i, and stores the additional value Pi + P(i) into the memory unit 16 again. Thus, only the additional value Pi + P(i) of the correlation value Pi which is greater than the threshold value THD is stored into the memory unit 16 as the new accumulated additional value P(i).

Further, since the above correlating calculation is performed by the matched filter 12 over the 32 frame terms, the accumulated

additional value of the correlation value Pi which is greater than the THD is stored as the new accumulated additional value P(i) in association with the point (phase shift amount) i into the memory unit 16.

In case that the accumulated additional value P(i) corresponding to the point (phase shift amount) i of the correlation value Pi, which is judged to be greater than the threshold value THD, is not stored in any memory area of the memory unit 16, i.e., in case that the correlation value Pi is firstly generated at a certain point (phase shift amount) i, the memory controller 14 reserves a new memory area to store this correlation value Pi in the memory unit 16, and actually stores this correlation value Pi into the new memory area as it is.

The memory unit 16 is constituted to store the accumulated additional value P(i) in association with the point (phase shift amount) i and has a temporary memory unit TM and a main memory unit MM as shown in FIG. 2.

The temporary memory unit TM and the main memory unit MM are connected to the memory controller 14, the adder 15 and the slot timing generator 17 through a control bus, an address bus and a data bus.

The main memory unit MM has a plurality of memory areas AM1, AM2, AM3, ..., which are assigned by memory addresses m = 1, 2, 3, ..., and stores a plurality of accumulated additional values P(i) into the memory areas AM1, AM2, AM3, ..., respectively for each point i, according to an instruction of the memory controller 14.

The temporary memory unit TM has a plurality of memory areas AT1, AT2, AT3, ..., which are assigned by memory addresses n = 1, 2, 3, ..., and stores the point i of the accumulated additional value P(i) stored in the main memory MM as well as index data D (i, m) to indicate the address m of the memory area where the accumulated additional value P(i) is stored, according to an instruction of the memory controller 14.

The main memory unit MM and the temporary memory unit TM do not have the memory capacity to store all the accumulated additional values corresponding to all the points (all the phase shift amount) i = 1 to 2560 as in the case of the related art.

More concretely, the memory unit 6 according to the related art shown in FIG. 8 stores all the accumulated additional values for 2560 points. Thus, the 2560 memory areas AP(1) to AP(2560) are prepared in advance. In contrast to this, according to the present embodiment, since the synchronization capture can be performed on the basis of the less number of the accumulated additional values, the total memory capacity of the main memory MM and the temporary memory unit TM is much less than that of the memory unit 6 in the related art.

Incidentally, the feature that the highly accurate synchronization capture can be established, even if the total memory capacity of the main memory unit MM and the temporary memory unit TM is much less than that of the related art, will be explained later together with the operation.

Next, the memory controller 14, the temporary memory unit

TM and the main memory unit MM are explained with reference to FIGs. 3A to 3B.

As shown in FIG. 3A, meaningless data (NULL data) are stored in the temporary memory unit TM and the main memory unit MM before the matched filter 12 starts the correlating calculation.

In this condition, when the matched filter 12 starts the correlating calculation and if the correlation value P50 which is greater than the threshold value THD at the point i = 50 in the first slot term for example, the memory controller 14 access the temporary memory unit TM to check whether or not the index data D (i, m) indicative of the point i = 50 is already stored therein.

In this case, since the NULL data is stored in the temporary memory unit TM as mentioned above, the memory controller 14 judges that the index data D (i, m) is not stored yet.

Then, as shown in FIG. 3B, the memory controller 14 stores the correlation value P50 as the accumulated additional value P(50) into the memory area AM1 of the main memory unit MM at the first address m = 1, and further stores the index data D (50, 1) into the memory area AT1 of the temporary memory unit TM at the first address n = 1. As a result, the accumulated additional value P (50) = P50 is stored in the main memory unit MM in association with the index data D (50, 1) stored in the temporary memory unit TM.

Consecutively, the correlating calculation is performed. Assuming that the correlation value P50 which is greater than the threshold value THD is calculated at the point i = 50 in the second slot term for example, the memory controller 14 accesses the

temporary memory unit TM to check the index data D (i, m) indicative of the point i = 50 is already stored therein.

In this case, as shown in FIG. 3B, since the index data D (50, 1) is stored, the memory controller 14 judges that the index data D (i, m) indicative of the point i = 50 is stored. Further, the memory controller 14 obtains the address m = 1 from the index data D (50, 1), and reads out the accumulated additional value P (50) stored in the memory area AM1 of the main memory unit MM at the address m = 1 and supplies it to the adder 15.

When the adder 15 adds the accumulated additional value P (50) and the correlation value P50 from the matched filter 12 together, the memory controller 14 again accesses the memory area AM1 of the main memory unit MM at the address m = 1 to store the additional value P50 + P (50) as a new accumulated additional value P (50) to the same memory area AM 1 as shown in FIG. 3C. Further, since the index data D (50, 1) is already stored in the temporary memory unit TM, the memory controller 14 does not store the index data (50, 1) into any other memory area but maintains it as it is in the memory area AM1 at the address n = 1.

Assuming that the correlation value P40 which is greater than the threshold value THD is calculated at the point i = 40 for example in place of the pint i = 50 in the second slot term, as shown in FIG. 3D, the correlation value P40 is stored as the accumulated additional value P (40) into the memory area AM2 o the main memory unit MM at the address m = 2, and further the index data D (40, 2) is stored into the memory area AT2 of the temporary memory

TM at the address n = 2. As a result, the accumulated additional value P (40) = P40 is stored into the main memory unit MM in association with the index data D (40, 2) stored in the temporary memory unit TM. Furthermore, the index data D (40, 2) and the accumulated additional value P (40) are packed and stored into the temporary memory unit TM and the main memory unit MM respectively.

In this manner, the accumulated additional values P (i) in the amount of 32 slot terms are stored into the main memory units MM, while the index data D (i, m) indicative of the memory address m and the point i of the accumulated additional values P (i) stored in the main memory unit MM are stored into the temporary memory TM.

Furthermore, since each accumulated additional value P (i) in the amount of 32 slot terms is accumulated by selecting only the correlation values Pi greater than the threshold value THD, the total number of the accumulated additional values P(i) is drastically less than the total number of the points i (e.g., 2560 points). Also, each accumulated additional value P(i) is packed and stored in the main memory unit MM in the younger order of the address m as shown in FIG. 4. As a result, the temporary memory unit TM and the main memory unit MM can store all the accumulated additional values P(i) by using the memory capacity much less than that of the memory unit 6 of the related art (refer to FIG. 8)).

The slot timing generator 17 extracts the greatest 20 accumulated additional values among all the accumulated additional

values in the amount of 32 slot terms which are finally stored in the main memory unit MM. Further, the slot timing generator 17 extracts the position of each point i corresponding respective one of the greatest 20 accumulated additional values from the index data D (i, m) stored in the temporary memory unit TM. Then, a histogram as shown in FIG. 5 is generated by arranging the greatest 20 accumulated additional values in the greater order. Furthermore, the position of the long code mark symbol in the received signal Sin is judged on the basis of the 20 points k in the histogram, and supplies the slot timing signal CLK synchronous with the position of the long code mark symbol to the spread series generator 18.

The spread series generator 18 generates the spread series signal SPN for inverse-spreading, in synchronization with the slot timing signal CLK and supplies it to the multiplier 20 in the decoding circuit 11.

Th band pass filter 19 passes the signal component Sin' having the frequency of the downstream communication line among the received signal Sin and supplies it to the multiplier 20.

The multiplier 20 generates the base band signal SB by multiplying the signal component Sin' and the spread series signal SPN, and decodes the data in each frame by supplying the base band signal SB to the decoder 21.

Next, one example of the operation of the portable information terminal of the present embodiment having the above described structure is explained with reference to a flow chart shown in FIG. 6.

When the electric power of the portable information terminal is turned on, the receiving process is started, and an initialization process is performed (step S100). In this initialization process, the received signal Sin is integrated for the predetermined time duration by the threshold generator 13b, and the time average of the integrated value is multiplied with the proportional coefficient α, so that the threshold value THD is determined. Further, the memory controller 14 clears up the temporary memory unit TM and the main memory unit MM, to store the NULL data to them. Furthermore, the memory addresses of the temporary memory unit TM and the main memory unit MM are set as n =1 and m = 1 respectively, and the value of a slot counter f built in the memory controller 14 is set to "1". This slot counter f is prepared for counting the order of the slot term for which the correlating calculation is performed.

Next, the value of a point counter i built in the memory controller 14 is set to "1" (step S101). This point counter i is prepared for counting the order of the point (phase shift amount) i of the correlation value Pi.

Then, the correlation value Pi is calculated by the matched filter 12 (step S104), and the calculated correlation value Pi and the threshold value THD are compared with each other by the comparator 13a (step S106).

Then, if Pi < THD (step S6: NO), the operational flow branches to a step S108, where the value of the point counter i is incremented and the correlating calculation from the step S104 is

repeated. On the other hand, if Pi ≧ THD (step S106: YES), the operational flow proceeds to a step S110. Therefore, the correlation value Pi less than the threshold value THD is abandoned while the process at the step S110 is performed only if the correlation value Pi greater than the threshold value THD is calculated at the step S104.

Then, the temporary memory unit TM is examined, and it is judged whether or not the index data D (i, m) corresponding to the value of the point counter i is stored in the temporary memory unit TM (step S110). Here, if the index data D (i, m) corresponding to the value of the point counter i is not stored (step S110: NO), it is judged that the correlation value Pi is firstly calculated at the point i, and the operational flow proceeds to a step S112, where the correlation value Pi is stored as the accumulated additional value P(i) into the memory area of the main memory unit MM at the memory address m (step S112). Further, the index data D (i, m) is stored into the memory area of the temporary memory unit TM at the memory address n (step S114). Then, the operational flow proceeds to a step S122.

On the other hand, at the step S110, if the index data D(i, m) corresponding to the value of the point counter i is stored (step S110: YES), the operational flow branches to a step S116, where the data at the memory address m corresponding to the point i is obtained from the index data D (i, m). Then, the memory controller 14 accesses the memory area at the address m of the main memory unit MM to read out the accumulated additional value P(i) which has been already stored therein, and calculates the additional value

Pi + P(i) (step S118). Then, this calculated additional value Pi + P(i) is stored as the new accumulated additional value P(i) into the memory area at the same address m (step S120). Then, the operational flow proceeds to a step S122.

Then, the value of the point counter i is incremented (step S122), and it is judged whether or not the value of the pointer counter i exceeds 2560 (step S124). If i > 2560 (step S124: YES), the operational flow proceeds to a step S126. On the other hand, if i $\leqq$ 2560 (step S124: NO), the processes from the step S104 to the step S124 are repeated. Therefore, until the value of the point counter i reaches 2560, the processes from the step S104 to the step S124 are repeated, so that the correlating calculations for 2560 points are repeated over one slot term, and further the accumulated additional values P(i) of the correlation values Pi which satisfy Pi $\geqq$ THD are stored in the main memory unit MM in association with the point i.

At the step S124, if i > 2560 (step S124: YES), it is judged that the correlating calculations for one slot term have been completed. Then, the value of the slot counter f is incremented (step S126), and it is judged whether or not the value of the slot counter f exceeds 32 (step S128). If if f $\leqq$ 32 (step S128: NO), the processes from the step S102 to the step S128 are repeated. Therefore, the correlating calculations are repeated for 32 slot terms, and the accumulated additional values P(i) of the correlation values Pi which satisfy Pi $\geqq$ THD are stored into the main memory unit MM in association with the point i.

In this manner, the correlating calculations for 32 slot terms are repeated, and when it becomes as f > 32 at the step S128 (step S128: YES), it is judged that the accumulated additional values for 32 slot terms as shown in FIG. 4 are stored in the main memory unit MM, and the operational flow proceeds to a step S130.

Then, the slot timing generator 17 extracts the greatest 20 accumulated additional values from among all the accumulated additional values for 32 slot terms finally stored in the main memory unit MM. Further, by extracting the position of each point i corresponding to respective one of those greatest 20 accumulated additional values from the index data D (i, m) stored in the temporary memory unit TM, the slot timing generator 17 generates the histogram as shown in FIG. 5 (step S130).

Then, the slot timing generator 17 judges the position of the long code mark symbol in the received signal Sin on the basis of the 20 points within this histogram, and supplies the slot timing signal CLK synchronous with the position of the long code mark symbol to the spread series generator 18 (S132).

By the processes described above, the synchronous capture to detect the position of the long code mark symbol in the received signal Sin is completed. Then, the spread series generator 18 generates the spread series signal SPN for inverse-spreading, in synchronization with the slot timing signal CLK, and supplies it to the multiplier 20 in the decoding circuit 11, so that the base band signal SB decodable at the best condition can be generated.

In this manner, according to the present embodiment, since

each accumulated additional value P(i) is calculated by extracting only the correlation value Pi greater than the threshold value THD, and is packed and stored into the main memory unit MM in association with each point i, it is possible to reduce the memory capacity of the memory unit 16.

In the above described embodiment, the correlating calculations are repeated over 32 slot terms. However, the present invention is not limited to the 32 slot terms. For example, it is possible to repeat the correlating calculations over appropriate slot terms.

In the above described embodiment, the case has been explained in which the present invention is applied to the CDMA method using the DS (Direct Sequence) method. However, the present invention is not limited to this method. For example, it is possible to apply the present invention to the CDMA method using FH (Frequency Hopping) method.

Further, although in the above described embodiment, the case has been explained in which the present invention is applied to the CDMA method, it is possible to apply the present invention to the FDMA method, the TDMA method and so forth.

Furthermore, although in the above described embodiment, the case has been explained in which the present invention is applied to the wireless type portable information terminal, it is possible to apply the present invention to any kind of communication technique regardless of the wireless or wire communication. For example, the present invention can be applied

to an optical LAN (Local Area Network) in which an optical fiber is used as a communication path, a wireless LAN in which the communication is performed by transmitting an optical signal in the air, and so forth.

The present invention can be applied to either one of the digital communication and the analog communication. In the present embodiment, although the case has been explained in which the signal is modulated by the PSK (Phase Shift Keying) method and is received, it is possible to apply the present invention to other types of the modulating methods, such as the ASK (Amplitude Shift Keying) method, the OOK (On-Off Shift Keying) method, the FSK (Frequency Shift Keying) and so forth.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

The entire disclosure of Japanese Patent Application No.11-256961 filed on September 10, 1999 including the specification, claims, drawings and summary is incorporated herein by reference in its entirety.

WHAT IS CLAIMED IS:

1. A communicating apparatus for performing an asynchronous communication with a base station, comprising:

a receiving device for receiving a down link signal, which is transmitted from the base station and in which a division signal is inserted for each of constant time intervals;

a detecting device for detecting division signals out of the received down link signal, in phase to the constant time intervals;

an adding device for adding the detected division signals over a predetermined time duration, which is longer than the constant time interval, with matching phases for each of the constant time intervals, so as to generate accumulated additional values; and

a memory device for storing the accumulated additional values generated by said adding device, to thereby perform synchronization capturing with the base station on the basis of the accumulated additional values added over the predetermined time duration and stored in said memory device.

2. A communicating apparatus according to claim 1, wherein said detecting device calculates a correlation between a signal correlated with the division signal and the received down link signal, and detects the division signal out of the received down link signal when the calculated correlation exceeds a predetermined threshold value.

3. A communicating apparatus according to claim 1, wherein said memory device has a plurality of memory areas to store the accumulated additional values with packing each of the accumulated additional values in respective one of the memory areas, when said adding device generates the accumulated additional values by adding at different timings within the constant time interval.

4. A communicating method of performing an asynchronous communication with a base station, comprising:

a receiving process of receiving a down link signal, which is transmitted from the base station and in which a division signal is inserted for each of constant time intervals;

a detecting process of detecting division signals out of the received down link signal, in phase to the constant time intervals;

an adding process of adding the detected division signals over a predetermined time duration, which is longer than the constant time interval, with matching phases for each of the constant time intervals, so as to generate accumulated additional values; and

a storing process of storing the accumulated additional values generated by said adding process into a memory device, to thereby perform synchronization capturing with the base station on the basis of the accumulated additional values added over the predetermined time duration and stored in said memory device.

5. A communicating method according to claim 4, wherein said detecting process calculates a correlation between a signal correlated with the division signal and the received down link signal, and detects the division signal out of the received down link signal when the calculated correlation exceeds a predetermined threshold value.

6. A communicating method according to claim 4, wherein

said memory device has a plurality of memory areas, and

said storing process stores the accumulated additional values with packing each of the accumulated additional values in respective one of the memory areas, when said adding process generates the accumulated additional values by adding at different timings within the constant time interval.

ABSTRACT OF THE DISCLOSURE

A communicating apparatus performs an asynchronous communication with a base station. The communicating apparatus is provided with: a receiving device for receiving a down link signal, which is transmitted from the base station and in which a division signal is inserted for each of constant time intervals; a detecting device for detecting division signals out of the received down link signal, in phase to the constant time intervals; an adding device for adding the detected division signals over a predetermined time duration, which is longer than the constant time interval, with matching phases for each of the constant time intervals, so as to generate accumulated additional values; and a memory device for storing the accumulated additional values generated by the adding device, to thereby perform synchronization capturing with the base station on the basis of the accumulated additional values added over the predetermined time duration and stored in the memory device.

FIG. 1

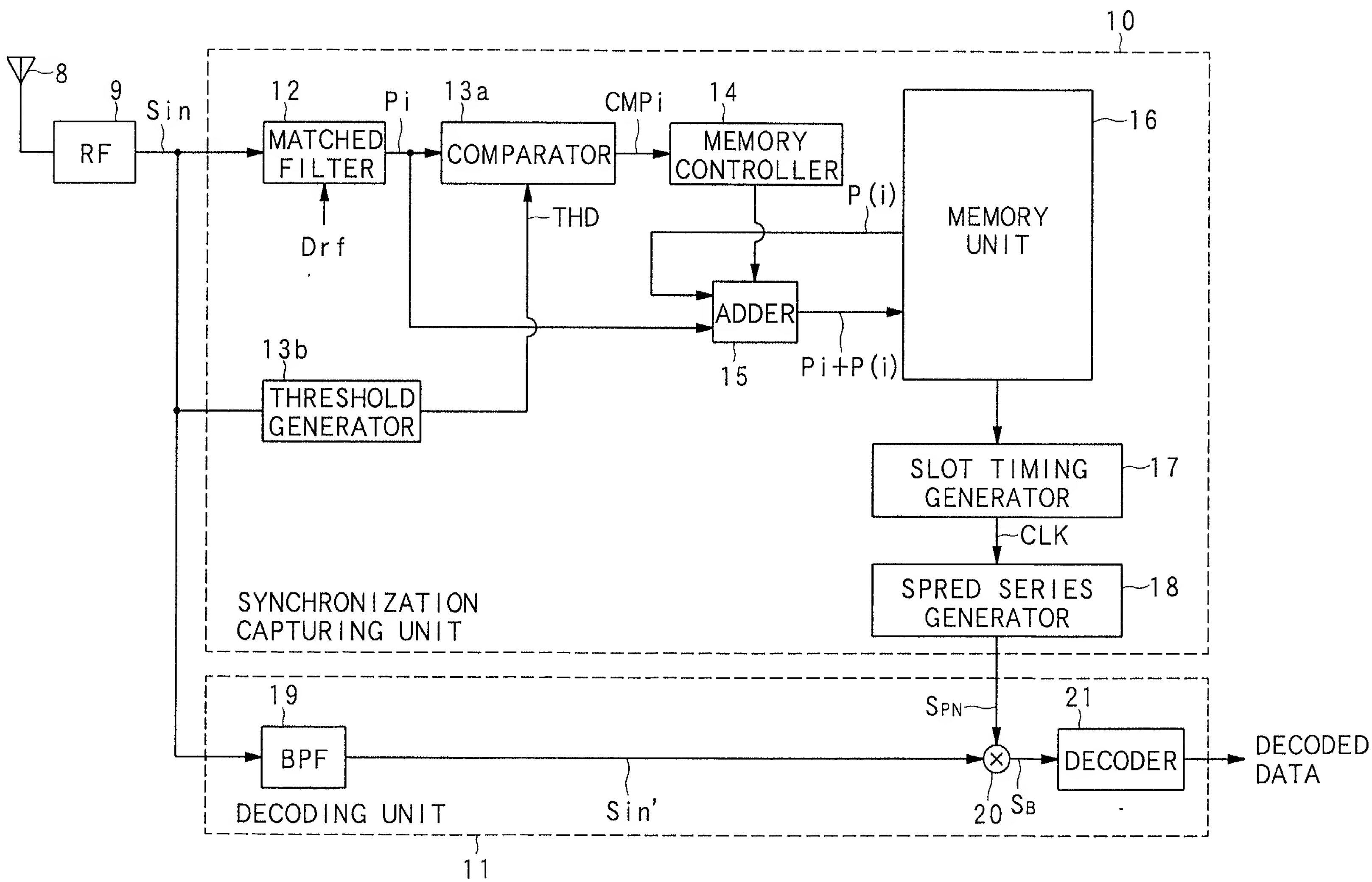

8
9
RF
Sin
10
12
MATCHED FILTER
Drf
Pi
13a
COMPARATOR
THD
CMPi
14
MEMORY CONTROLLER
P(i)
16
MEMORY UNIT
ADDER
15
Pi+P(i)
13b
THRESHOLD GENERATOR
SLOT TIMING GENERATOR
17
CLK
SPRED SERIES GENERATOR
18
SYNCHRONIZATION CAPTURING UNIT
19
BPF
Sin'
SPN
20
SB
21
DECODER
DECODED DATA
DECODING UNIT
11

FIG. 2

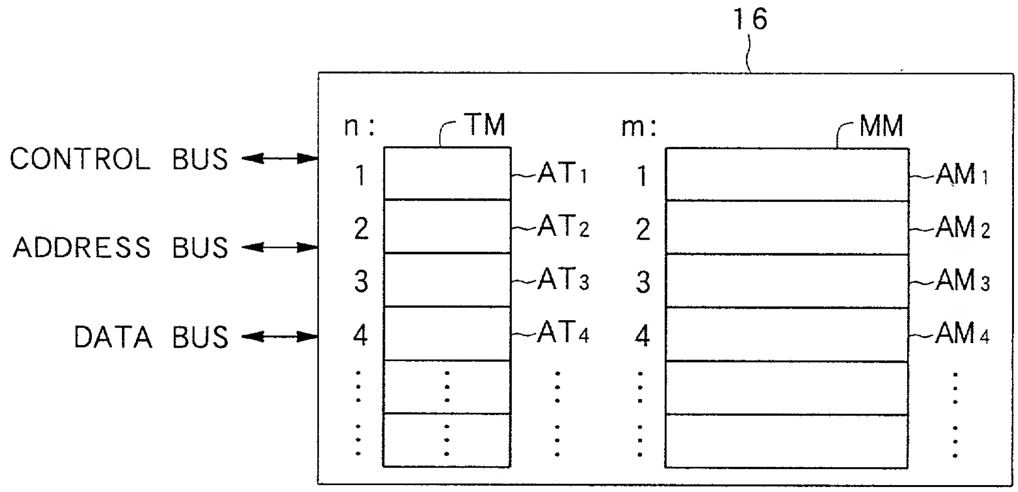

16
CONTROL BUS
ADDRESS BUS
DATA BUS
n:
TM
1
2
3
4
AT1
AT2
AT3
AT4
m:
MM
1
2
3
4
AM1
AM2
AM3
AM4

FIG. 3A

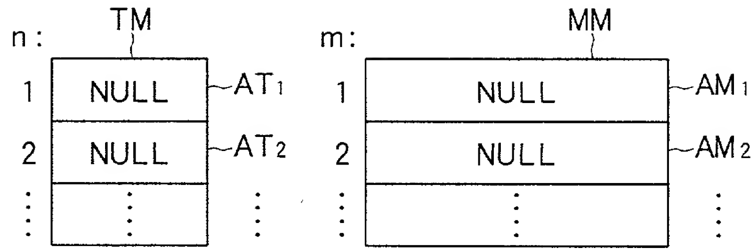


FIG. 3B

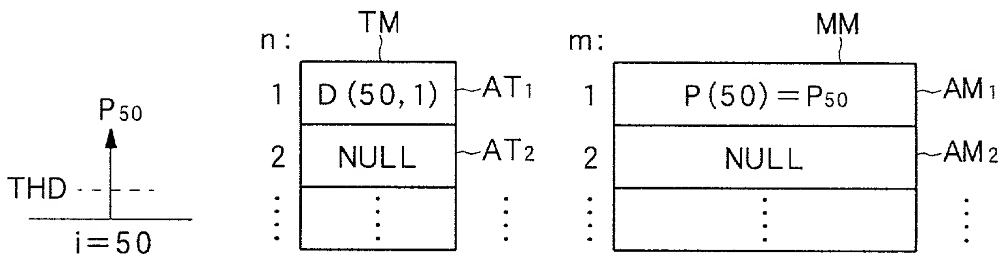


FIG. 3C

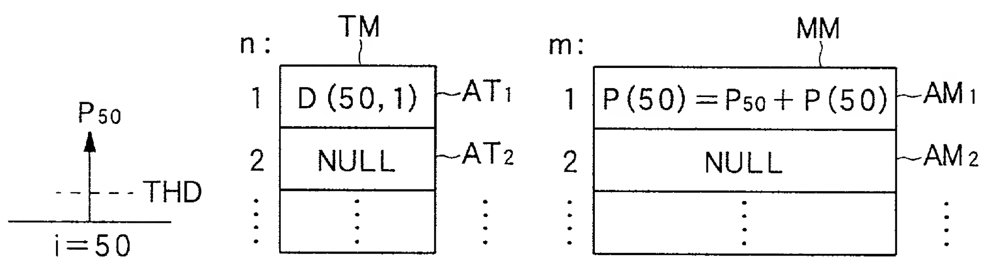


FIG. 3D

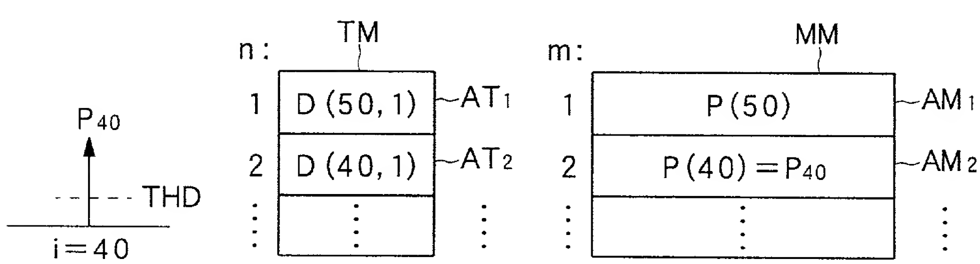
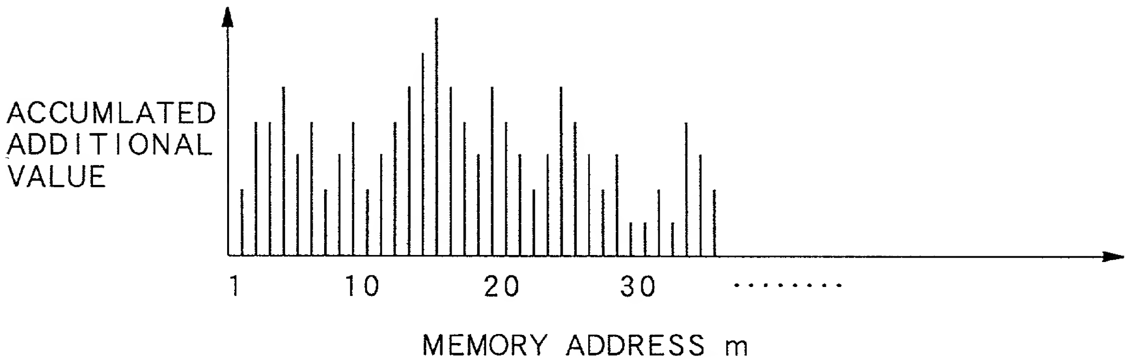
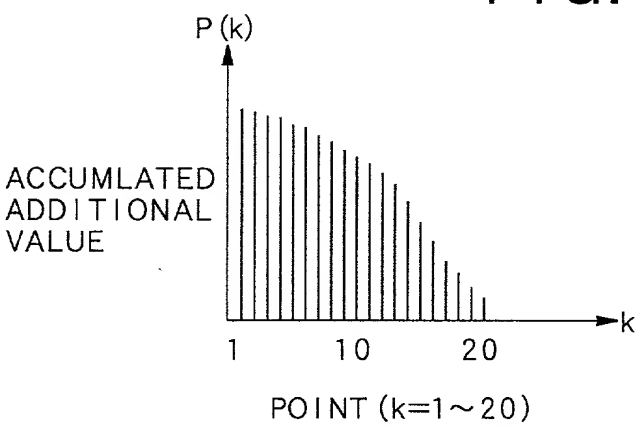


FIG. 4



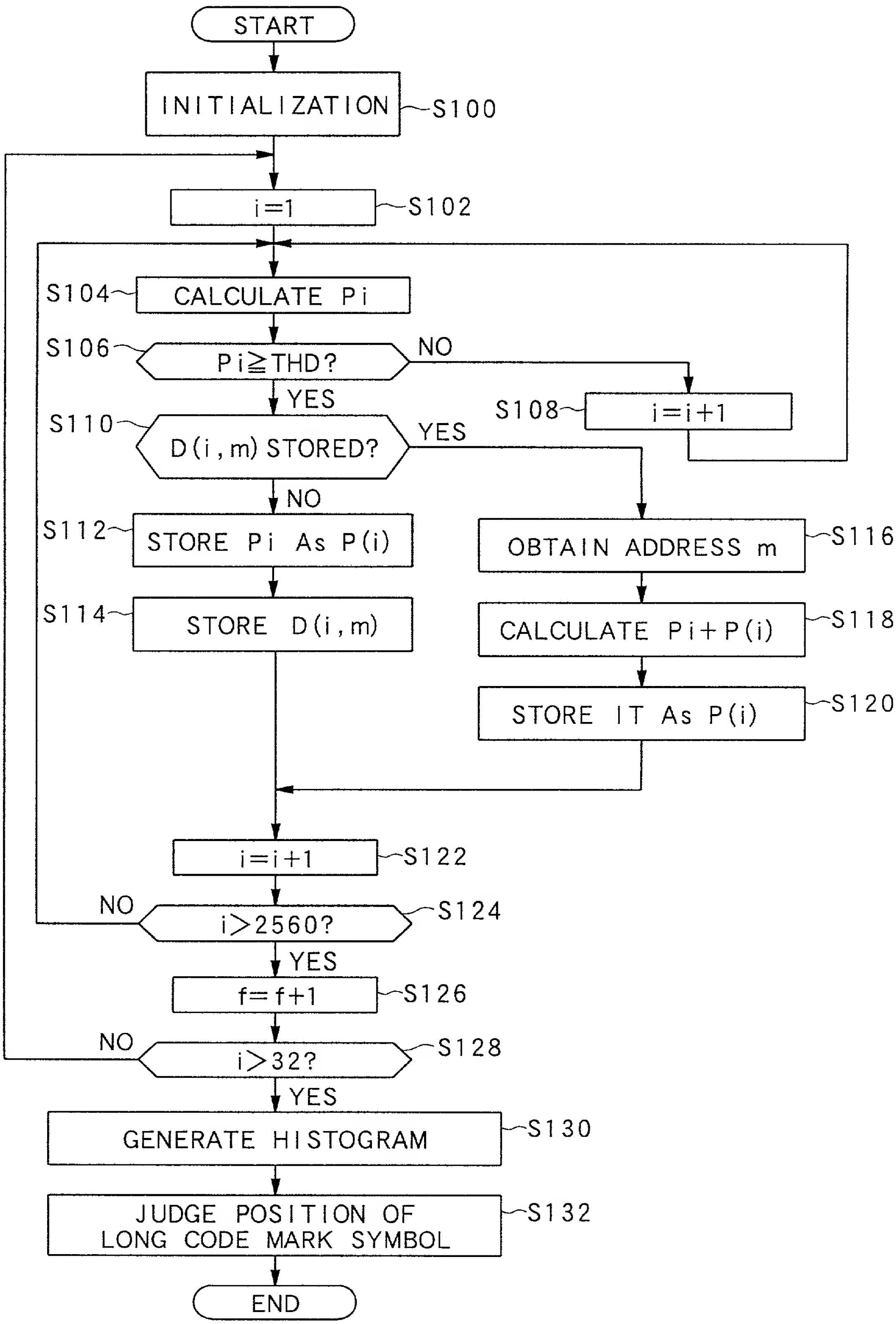
ACCUMLATED
ADDITIONAL
VALUE
1
10
20
30
MEMORY ADDRESS m

FIG. 5



P(k)
ACCUMLATED
ADDITIONAL
VALUE
k
1
10
20
POINT (k=1~20)

FIG. 6



START
INITIALIZATION
S100
i=1
S102
S104
CALCULATE Pi
S106
Pi≧THD?
NO
YES
S108
i=i+1
S110
D(i, m) STORED?
YES
NO
S112
STORE Pi As P(i)
S114
STORE D(i, m)
OBTAIN ADDRESS m
S116
CALCULATE Pi+P(i)
S118
STORE IT As P(i)
S120
i=i+1
S122
NO
i>2560?
S124
YES
f=f+1
S126
NO
i>32?
S128
YES
GENERATE HISTOGRAM
S130
JUDGE POSITION OF
LONG CODE MARK SYMBOL
S132
END

FIG. 7

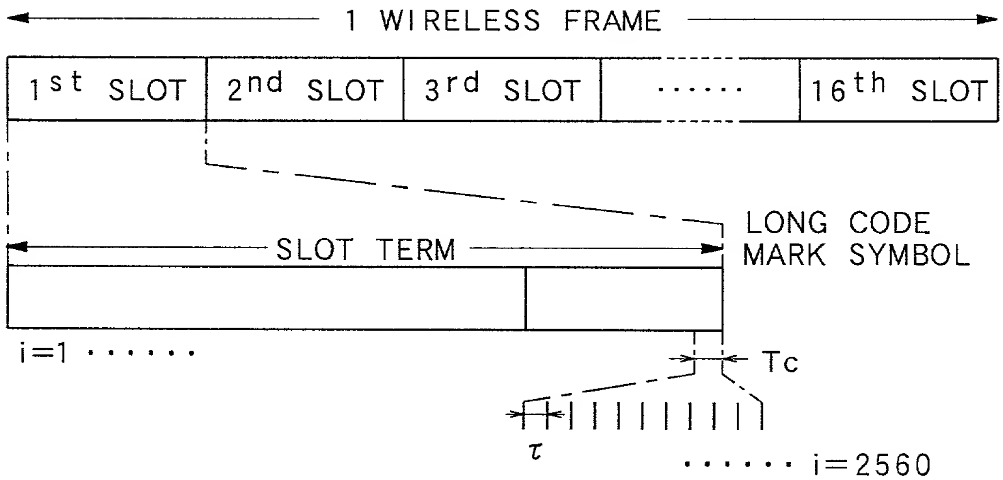

1 WIRELESS FRAME
1st SLOT
2nd SLOT
3rd SLOT
......
16th SLOT
SLOT TERM
LONG CODE
MARK SYMBOL
i=1 ......
Tc
τ
...... i=2560

FIG. 8

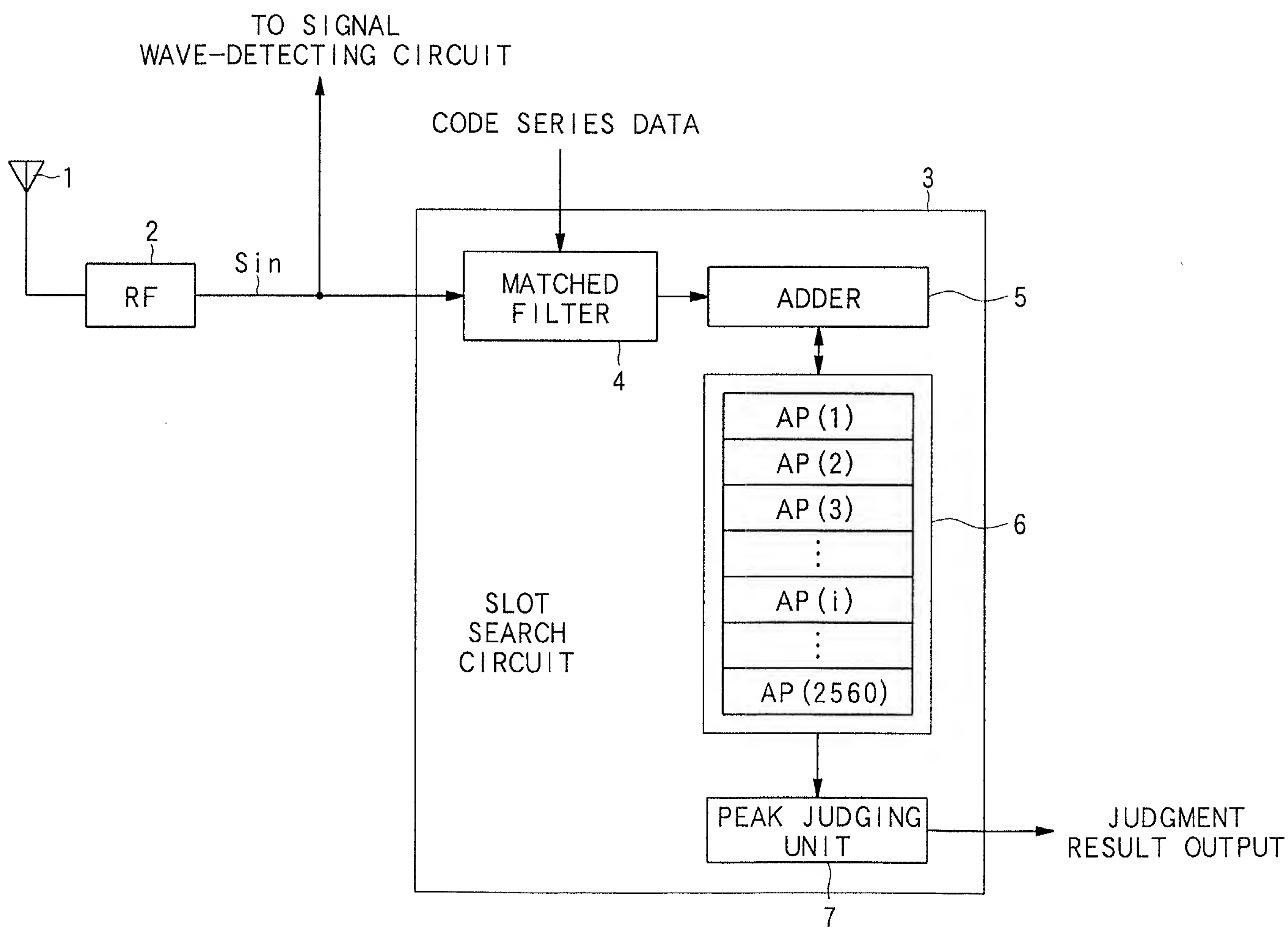

TO SIGNAL
WAVE-DETECTING CIRCUIT
CODE SERIES DATA
1
2
RF
Sin
3
MATCHED
FILTER
4
ADDER
5
AP (1)
AP (2)
AP (3)
AP (i)
AP (2560)
6
SLOT
SEARCH
CIRCUIT
PEAK JUDGING
UNIT
7
JUDGMENT
RESULT OUTPUT

FIG. 9

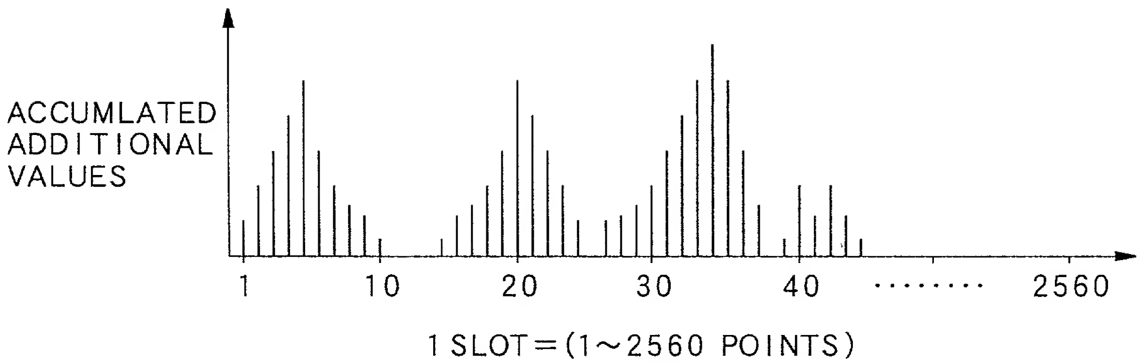
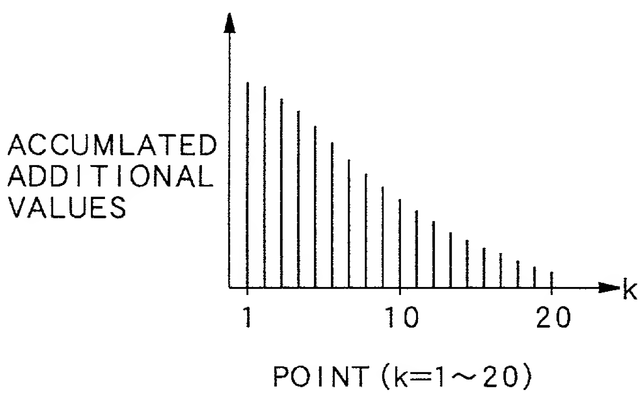

ACCUMLATED
ADDITIONAL
VALUES
i
1
10
20
30
40
....
2560
1 SLOT=(1～2560 POINTS)

FIG. 10


ACCUMLATED
ADDITIONAL
VALUES
k
1
10
20
POINT (k=1～20)

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

As a below named inventor, I hereby declare that:

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

My residence, post office address and citizenship are as stated next to my name.

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

COMMUNICATING APPARATUS AND COMMUNICATING METHOD

上記発明の明細書（下記の欄でx印がついていない場合は、本書に添付）は、

the specification of which is attached hereto unless the following box is checked:

☐ __月__日に提出され、米国出願番号または特許協定条約国際出願番号を__________とし、（該当する場合）__________に訂正されました。

☐ was filed on __________ as United States Application Number or PCT International Application Number __________ and was amended on __________ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第３７編第１条５６項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

P01-3930

Japanese Language Declaration
(日本語宣言書)

私は、米国法典第３５編１１９条(a)-(d)項又は３６５条(b)項に基き下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約３６５(a)項に基ずく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Not Claimed 優先権主張なし
P11-256961	Japan	10/09/1999	☐
			☐

私は、第３５編米国法典１１９条(e)項に基いて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)

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I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

P01-3930

Japanese Language Declaration
(日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。（弁護士、または代理人の氏名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith *(list name and registration number)*
registered practitioners of Morgan, Lewis & Bockius LLP listed in Customer Number 009629

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Direct Telephone Calls to: (*name and telephone number*)

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第二共同発明者 日付	Second inventor's signature TAKEHICO SHIODA	Date August 30, 2000
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国籍	Citizenship Japanese	
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	No. 6-1-1 Fujimi, Tsurugashima-shi, Saitama-ken, Japan	

（第三以降の共同発明者についても同様に記載し、署名をすること）

(Supply similar information and signature for third and subsequent joint inventors.)

Japanese Language Declaration

第3の共同発明者の氏名（該当する場合）	Full name of *third* joint inventor, if any Katsunori ARAKAWA
同第3発明者の署名　　日付	*Third* Inventor's signature　　Date *Katsunori Arakawa*　　August 30, 2000
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国籍	Citizenship Japanese
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同第4発明者の署名　　日付	*Fourth* Inventor's signature　　Date *Osamu Yamazaki*　　August 30, 2000
住所	Residence Tsurugashima-shi, Saitama-ken, Japan
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Pioneer Corporation, Sougou Kenkyusho.
	No. 6-1-1 Fujimi, Tsurugashima-shi, Saitama-ken, Japan

第5の共同発明者の氏名（該当する場合）	Full name of *fifth* joint inventor, if any Masami SUZUKI
同第5発明者の署名　　日付	*Fifth* Inventor's signature　　Date *Masami Suzuki*　　August 30, 2000
住所	Residence Tsurugashima-shi, Saitama-ken, Japan
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Pioneer Corporation, Sougou Kenkyusho.
	No. 6-1-1 Fujimi, Tsurugashima-shi, Saitama-ken, Japan
第6の共同発明者の氏名（該当する場合）	Full name of *sixth* joint inventor, if any Yasuteru KODAMA
同第6発明者の署名　　日付	*Sixth* Inventor's signature　　Date *Yasuteru Kodama*　　August 30, 2000
住所	Residence Tsurugashima-shi, Saitama-ken, Japan
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Pioneer Corporation, Sougou Kenkyusho.
	No. 6-1-1 Fujimi, Tsurugashima-shi, Saitama-ken, Japan

（第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)

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第7の共同発明者の氏名（該当する場合）	Full name of Seventh joint inventor, if any Masahiro OKAMURA
同第7発明者の署名 日付	Seventh Inventor's signature Date Masahiro Okamura August 30, 2000
住所	Residence Tsurugashima-shi, Saitama-ken, Japan
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Pioneer Corporation, Sougou Kenkyusho.
	No. 6-1-1 Fujimi, Tsurugashima-shi, Saitama-ken, Japan
第8の共同発明者の氏名（該当する場合）	Full name of eighth joint inventor, if any Takayuki AKIMOTO
同第8発明者の署名 日付	eighth Inventor's signature Date Takayuki Akimoto August 30, 2000
住所	Residence Tsurugashima-shi, Saitama-ken, Japan
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Pioneer Corporation, Sougou Kenkyusho.
	No. 6-1-1 Fujimi, Tsurugashima-shi, Saitama-ken, Japan

第9の共同発明者の氏名（該当する場合）	Full name of nineth joint inventor, if any Hiroto INOUE
同第9発明者の署名 日付	Nineth Inventor's signature Date Hiroto Inoue August 30, 2000
住所	Residence Tsurugashima-shi, Saitama-ken, Japan
国籍	Citizenship Japanese
郵便の宛先	Post Office Address c/o Pioneer Corporation, Sougou Kenkyusho.
	No. 6-1-1 Fujimi, Tsurugashima-shi, Saitama-ken, Japan
第10の共同発明者の氏名（該当する場合）	Full name of tenth joint inventor, if any
同第10発明者の署名 日付	Tenth Inventor's signature Date
住所	Residence
国籍	Citizenship
郵便の宛先	Post Office Address

（第六またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。）

(Supply similar information and signature for third and subsequent joint inventors.)